"AN EXPERIMENTAL STUDY TO ANALYSE THE EFFECTS OF LOWER EXTREMITY FUNCTIONAL EXERCISE ON THE PHYSICAL CAPACITY IN MODERATE COPD PATIENTS"

-AN EXPERIMENTAL STUDY

A DISSERTATION SUBMITTED TO THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY, CHENNAI, AS PARTIAL FULFILLMENT OF THE MASTER OF PHYSIOTHERAPY DEGREE

APRIL 2012.

CERTIFICATE

Certified that this is the bonafide work of **MR.E.U.RAVISANKAR** of K.G. College of Physiotherapy, Coimbatore submitted in partial fulfillment of the requirements for the Master of Physiotherapy Degree course from the Tamil Nadu Dr.M.G.R. Medical University under the **Registration No: 27102216** for the April 2012 Examination.

Place : Coimbatore Principal

Date :

“AN EXPERIMENTAL STUDY TO ANALYSE THE EFFECTS OF LOWER EXTREMITY FUNCTIONAL EXERCISE ON THE PHYSICAL CAPACITY IN MODERATE COPD PATIENTS”.

Under the guidance of,

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Internal Examiner **External Examiner**

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I INTRODUCTION

COPD is the 5th cause of mortality and morbidity in the world and represent in economic and social burden. COPD is the chronic obstructive pulmonary disorder affecting 10 – 15 individuals over age of 45. WHO estimates, COPD is a simple cause of death, mainly affecting the middle aged and elderly people. Some of the risk factors for COPD include smoking, occupational postures, air pollution, hyper-responsiveness of airways and certain genetic variations.

The prevalence of death rate due to COPD are increasing proportionately in accordance with increase in smoking cessation, disease education, early detection and treatment will provide benefit against the cause of mortality and morbidity.

COPD occur among 4 % to 10 % of adult male population in INDIA and in other countries. The regional COPD working group for 12 Asia pacific countries used a COPD prevalence model and estimated an overall prevalence rate of 35 % - 67 %.

By 2020 COPD is expected to rise to third position, as a cause of death and fifth position as a cause of Disability Adjusted Life Years (DALYS) as per the baseline prosecutions made in global burden or disease study.

According to the American Thoracic Society (ATS), COPD is a disease that is characterized by the presence of airway limitations to chronic bronchitis or emphysema. The obstruction to airflow is generally incremental may be accompanied by hyperactivity of airways and may be partially reversible.

Statement by the European Respiratory Society (ERS) on COPD is reduced maximum respiratory flow and slow forced emptying of the lungs, which is slowly incremental and mostly reversible to medical treatment.

According to Global initiative for chronic obstructive lung diseases (GOLD), COPD is a disease that is characterized by limitation to air flow which is not fully reversible .The airflow limitation is usually both incremental and it is associated with an abnormal inflammatory response or the lungs to noxious particles or gases.

Factors like increased visceral mass, improper posture, respiratory disease, muscle weakness and ageing lead, to compromise in breathing mechanics that arise from shortening of the muscle, of respiration in turn affecting their ability to produce tension. This ultimately decreases the working ability of the respiratory musculature leading to reduction in the overall quality of life.

COPD affects the mechanics of lungs and distal musculature. The maneuvers that are assigned for this condition are usually towards the improvement on endurance programs that are focused towards positive changes in thoracic mobility and their muscles are rare.

Studies suggest that exercise aimed to the increasing mobility on chest wall improve thoracic mobility and exercise capacity reduce breathlessness and symptoms of depression in patients with COPD. (Elaine Pauline et al 2003)

It is probably revealed that diaphragmatic muscle dysfunction during rest does not limit ventilator requirements, but it produces reduction in functional exercise capacity and respiratory failure during activities and exercise induced exacerbations.

Exercise intolerance is ubiquitous in patients suffering from chronic obstructive pulmonary disease (COPD). Functional impairment can be evidenced by a lower walking capacity and cycling endurance compared with age-matched healthy controls. Reduced functional status and low level of daily physical activity predict poor quality of life, high health care use, and mortality in these patients. (Casaburi, 1993) A comprehensive understanding of the mechanisms of exercise intolerance is therefore of utmost importance to impact on these adverse outcomes and modify the evolution of the functional impairment associated with COPD.

Muscle atrophy and impaired energy production are accountable for muscle weakness and increased susceptibility to fatigue, two strong determinants of exercise capacity. If peripheral muscle weakness is responsible for the reduced exercise capacity, then one would expect that increases in muscle strength would lead to improvements in exercise performance.

A maximally intense aerobic exercise programmed can be created for most COPD patients that can significantly improve both skeletal and respiratory muscle strength and endurance as well as dyspnoea. (John, 2000)

Aerobic training should involve the major muscle groups of lower extremity as they are used in everyday tasks such as walking and climbing stairs. In addition to breathing strategies exercise training can help in patient's scope with periods of breathlessness and reduce anxiety. The American college of sports medicine supports that light to moderate physical activity is beneficial for improving the quality of life in persons with COPD.

Exercise can improve endurance and strength as well as breathing efficiency and tolerance in COPD patients especially in severely impaired persons with COPD who follows an individualized progressive exercise programmed can often increase their functional capacity 70% to 80% after 6 weeks of training. Lack of exercise contributes to disability in COPD.

Exercise training is a major component of pulmonary rehabilitation programmers and is an established safe and effective intervention for improving physical capacity and quality of life. Regular strength training exercise enables COPD patients to do more recreational and vocational activities despite their lung disease combined resistance training with an aerobic training programmed help in increase endurance. Exercise for strengthening should include all major muscles and as muscle strength and endurance improve more sets can be added to each exercise.

1.1 NEED FOR THE STUDY

The impaired muscle endurance and strength are associated with reduced exercise capacity contributing to impaired quality of life and leads to the increased, use of health care resources in COPD patients.

Previous studies have emphasized the usefulness of lower extremity strength training and endurance training alone.

Few studies have shown the effective outcomes of functional exercise, in counter measuring the muscle dysfunction in COPD patients.

The present study, was aimed to investigate the effect of functional exercise for lower limb muscle dysfunction in improving the COPD patients functional capacity.

1.2 OBJECTIVES OF THE STUDY

To investigate the effects of lower extremity functional exercise on the physical capacity in moderate COPD patients .

1.3 HYPOTHESIS

NULL HYPOTHESIS

There is no significant improvement in the physical capacity of moderate COPD patients after lower extremity functional exercise.

ALTERNATE HYPOTHESIS

There is a significant improvement in the physical capacity of moderate COPD patients after lower extremity functional exercise.

II REVIEW OF LITERATURE

N.A.Hernandes , E.F.M . Wouters et al., (2011)

They conducted a study to assess the reproducibility of 6 minute walking test in patients with COPD. A total of 1514 patients COPD patients participated in the study. 6 minute walk test was performed on the subsequent days. The study aimed at assessing the effects of 6 minute walk test. On the basis of study results they concluded that the 6 minutes' walk test was reproducible in a representative sample of patients with COPD. The vast majority of patients improved significantly in the second test.

Hannink Jorien et al., (2011)

The study was conducted to compare the effects of dynamic hyperinflation during the arm and leg exercise in patients with COPD. 30 Patients with mild to moderate COPD were selected for the study. The patients were made to perform arm and leg constant work rate ergometry. The leg load was measured using a incremental leg test and changes in inspiratory capacity was measured at rest and at 2 min interval. On the basis of the study findings they concluded that there was an increase dynamic hyperinflation during the leg exercises than the arm exercises.

Georg - Christian Funk et al., (2009)

They conducted a study to compare the effects of BODE index and GOLD criteria in assessing the effects of common treatable risk factors in patients with COPD. On the basis of the study results they concluded that the GOLD criteria were superior to the BORD index in assessing the treatable risk factors in COPD patients.

Mohammed R Zainuldin et al., (2007)

They conducted a study to determine the cycle training intensity from six minute walk test in COPD patients . A total of 35 patients with stable COPD participated in the study .On the basis of results they concluded that the 6 minute walk test gave a reliable values for .prescribing the cycle training intensity for COPD patients referred for pulmonary rehabilitation patients .

Wust RC .Degens H et al., (2007)

They conducted a study to investigate the factors responsible for muscle wasting and dysfunction in COPD patients. COPD patients normally suffer from exercise intolerance due to insufficiency in skeletal muscles rather than due to pulmonary problems .Study findings showed that disuse, hyopemia, malnutrition , oxidative stress and systemic inflammation were the causes for the muscle atrophy.

Boers et al., (2007)

This study was conducted with the aim of evaluating the effects of six minute walk test inducing systemic inflammation and oxidative stress in muscle wasting COPD patients. 10 COPD patients with muscle-wasting were selected for the study .Six minute walk test and cardiopulmonary exercise testing was done for the subjects. The study findings showed that the six minute induced a systemic inflammatory response in COPD patients with muscle wasting when compared with that of cardiopulmonary exercise testing response.

Walker et al., (2007)

They conducted a study to analyze the effects of lower extremity activity and its determinants in patients with COPD. 45 patients with COPD and 18 age matched controls were selected for the study. The COPD patients underwent a 8 weeks of rehabilitation program in which the changes in leg activity was measured .The study findings concluded that the leg activity in the COPD patients was reduced when compared with their age matched controls .

Mannino David M et al., (2006)

This study aimed to determine the efficiency of GOLD classification in predicting the mortality of COPD patients. 15759 COPD patients were included in the study. The patients were classified on the basis of the GOLD criteria .Results

showed that 8% of patients died during the study period. The overall death was 8.9% per 1000 persons .On the basis of study findings they concluded that the GOLD classification was a good predictor of higher risk of death in COPD patients.

Bernice H et al., (2005)

The study aimed at assessing the risk factors of Chronic Obstructive Pulmonary Disease (COPD) .In this genetic epidemiologic study conducted the authors identified that smoking, age, race, sex were all the certain contributing risk factors for COPD. They concluded that along with cigarette smoking there are other risk factors for COPD such as alpha antitrypsin variation, low socio-economic status and the ABO blood groups.

Alejandro Cases et al., (2005)

The study was conducted to evaluate the effects of six minute walk test in COPD patients. 8 patients with moderate to severe COPD were included in the study. They all underwent the six minute walk test and standard incremental shuttle test for identifying the peak walking speed. On the basis of the study findings they concluded that the six minute walk test had a maximum sustainable exercise in COPD patients than the standard incremental shuttle test.

Franssen et al., (2005)

They study was conducted to evaluate the effects of limb dysfunction in COPD. 59 stable COPD patients were included in this study. Their leg and arm muscle function were evaluated. Fat free mass was measured using a bioelectric impedance device. Isokinetic quadriceps and biceps strength was measured using the biodex dynamometer. The study findings showed that there was a generalized muscle weakness and there was a preserved arm endurance and the poor arm response for exercise training is indicative of differences in muscular adaptations between the leg and arm muscles.

Alberto Nender et al., (2004)

They conducted a study to determine the exercise endurance capacity in COPD patients. A total of 8 non-hypoxemic patients in the experimental group along with 10 normal subjects in the control group were included in the study .All the subjects underwent an initial maximal incremental exercise test on cycle ergo meter followed by four high intensity constant load tests , conducted each on subsequent days . On the basis of the study findings they concluded that there was a reduction in power – endurance relationship in patients with COPD than the healthy constraints .

Polkey et al., (2003)

This study was conducted to analyze the effects of peripheral muscle weakness in patients with COPD , 34 men with moderate obesity was included for the study .The muscle strength of the lower extremity of the patients was measured using volitional muscle strength tests . On the basis of the study findings the author concludes that patients with COPD exhibit a decrease in the quadriceps muscle strength due to the exacerbations.

O'Donnell DE et al., (2002)

They conducted the study to evaluate the physiological response of six minute walk test in patients with chronic obstructive pulmonary disease .20 male patients were selected for the study .Six minute walk test was conducted for all the subjects. The pulmonary O2 uptake and forced expiratory volume in one second FEV1 were measured during the six minute walk test .The results demonstrated that the six minute walk test increased the oxygen uptake , which was an indicator for the high prognostic value of the six minute walk test .

Engels HJ et al., (2002)

They conducted a study to evaluate the effect of bench step training on the muscular fitness , body composition profile and psychological effect .44 healthy adult females were included in the study .Patients performed a 12 weeks of bench

step exercise with 3 sessions a week for 50 mins . On the basis of the study findings they concluded that the subjects who participated in the bench step exercise showed an improved level of muscular fitness and psychological fitness .

Nestorv A . Molfino et al., (2000)

They conducted a study to evaluate the histopathology , inflammatory process of the chronic obstructive pulmonary disease . Chronic obstructive pulmonary disease is an evolving worldwide health problem with increasing rates of mortality and morbidity . It is a progressive inflammatory condition affecting the conducting airways and lung parenchyma .This study reveals the focus on the abnormal inflammatory response of COPD in different parts of the conducting airways .

Vanessa Noonan et al., (2000)

They conducted a study to compare the effects of maximal exercise testing and the sub maximal exercise testing .The study aimed at assessing the reliability and validity of maximal and sub maximal exercises. Tests involved measuring the subjects response to physical activities of daily life . The study findings shows that the sub maximal exercise showed beneficial effects than the maximal exercise .

Clark CJ Cochrane LM et al., (2000)

The study was conducted with the aim of assessing the skeletal muscle strength and endurance in COPD patients .43 COPD patients were included in the study . Their isokinetic and isotonic muscle function, whole body endurance was measured. The study findings showed that the COPD patients had a reduced isokinetic muscle function.

Daniel R Smith et al., (2000)

This study was evaluated to assess the reliability and validity of six minute walk test in assessing the functional status of patients with cardiopulmonary disease. The test includes the basic parameter of total distance walked for a specified time. On the basis of the study findings the authors concluded that the six minute walk test a reliable and valid tool for measuring the functional status of patients with cardiopulmonary disease .

Sarah Bernard et al., (1998)

They conducted a study to evaluate the peripheral muscle weakness in COPD patients . 34 COPD patients were included in this study . Their quadriceps strength and thigh cross sectional area was measured .The study results shows that there was a reduction in the quadriceps strength and this was due to the airflow obstruction and chronic inactivity and muscle deconditioning in COPD patients .

Mackay E et al., (1996)

The study was conducted to study the effects of low intensity peripheral muscle conditioning in patients with COPD .The study aimed at assessing the effects of muscle conditioning in peripheral muscles .48 patients aged 40-72 years were included in the study .The peripheral muscle endurance , strength , whole body endurance , maximal exercise capacity were measured before and after the 12 week study period .The study findings showed that the training group showed an improvement in the measures of upper and lower peripheral muscle performance .

Anoma Santiworakul et al., (1995)

They conducted this study to evaluate the effects of lower extremity exercise on muscle strength and physical capacity in patients with COPD .20 COPD patients were selected for the study , they were divided into 2 groups .One was a training group and the other was a control group . The training group underwent a 8 weeks of lower extremity functional exercise .The patients maximum muscle strength and six minute walk test was measured in the pre-training session and the post-training session . On the basis of the study results they concluded that lower extremity functional exercise may improve the physical capacity of COPD patients.

M.Jeffery Mador (1994)

He conducted a study to analyze the effects of lower extremity exercise training in patients with COPD. 50 patients with COPD were selected for the study. The patients were given two – leg cycle training and one – leg cycle training. The maximal minute ventilation was measured before and after the training sessions. On the basis of the study findings the author concluded that the maximal minute ventilation improved during the one – leg cycle training session in patients with COPD.

Ortega et al., (2002)

Ortega and colleagues aimed to compare the effects of strength and endurance training in patients with chronic obstructive pulmonary disease and they found no difference in the extent of improvement in strength following combined training compared to strength training alone in patients with COPD exercising three times a week

Bernard et al., (1999)

The purpose of this study was to evaluate whether strength training is a useful addition to aerobic training in patients with chronic obstructive pulmonary disease (COPD). Forty-five patients with moderate to severe COPD were

randomized to 12 wk of aerobic training alone (AERO) or combined with strength training (AERO + ST).It concluded that strength training was effective at making the muscles stronger, this increase in strength did not translate into additional improvements in exercise performance or quality of life from that observed following endurance training only.

Gosselink R, Decramer M (1998)

They discussed the contribution of peripheral muscle function and muscle training to exercise performance, in three questions: 1) Is peripheral muscle dysfunction contributing to exercise limitation in COPD? 2) How do we measure peripheral muscle function? 3) are peripheral muscle training modalities effective? They concluded that muscle weakness is associated with impaired exercise capacity and symptoms of increased exertion during exercise. Endurance exercise training, i.e. cycling and treadmill walking, improved exercise capacity and was associated with alterations in muscle metabolism. Strength training of peripheral muscles showed increases in submaximal exercise performance and quality of life measures. These improvements were observed independently of the degree of airflow obstruction.

Gosselink R et al., (2002)

The study focused to determine the degree of respiratory and peripheral muscle weakness in patients with moderate to severe chronic obstructive pulmonary disease (COPD). 22 healthy elderly subjects and 40 consecutive COPD patients were included. The study stated that, muscle weakness in stable COPD patients does not affect all muscles to a similar extent. Inspiratory muscle force is affected more than peripheral muscle force, whereas proximal upper limb muscle strength was impaired more than distal upper limb muscle strength.

Hamilton DM, Haennel RG (2000)

The 6-minute walk is a valid and reliable method of assessing functional ability in a Phase II/III CR population. A learning effect of 6% was observed over the three walks; however, it is unknown if this learning effect will be retained over time. This test may be particularly valuable to smaller CR centers that want to document functional improvements but do not have access to conventional treadmill tests.

Degens H et al., (2005)

They tried to find out the preservation of skeletal muscle contractility in COPD patients with normal fat-free mass. Study found that skeletal muscle

strength, contractile properties and fatigability are preserved in patients with moderate COPD and a normal FFM and activity level. This suggests that skeletal muscle dysfunction does not take place during moderate COPD until cachexia and/or a decline in physical activity occur.

Singer J et al., (2011)

This study sought to quantify the impact of respiratory muscle and lower extremity strength on exercise capacity and lower extremity function (LEF) in 828 patients with chronic obstructive pulmonary disease (COPD).They found, In COPD, reduced respiratory and lower extremity muscle strength are associated with decreased exercise and functional capacity. Muscle weakness is likely an important component of impairment and disability in patients with COPD.

Fischer et al., (2010)

The purpose of this study was to investigate whether negative affect and beliefs about exercise of patients with COPD would be related to baseline 6-min walk (6-MW) test results in a pulmonary rehabilitation setting, after correction for physical variables (sex, age, height, weight, and lung function). A second aim was to examine whether patients' beliefs are associated with treatment outcomes, as measured by an improvement in 6-MW distance. They conclude that patients'

beliefs about the negative consequences of exercise are associated with baseline 6-MW test performance and response to treatment for patients with mild to moderate COPD. We recommend that patients' concerns about exercise are discussed and, if necessary, corrected during the intake phase.

Loy SF et al., (2009)

The purpose of this investigation is to assess the effects of a 6-week aerobic exercise training program on autonomic modulation of heart rate in patients with COPD. Forty patients of both sexes with moderate-to-severe COPD were randomly allocated to aerobic exercise training (PT, $n = 20$) or to usual care (Control, $n = 20$). In conclusion, neural control of heart rate, in addition to other clinically valuable measures, is positively altered in moderate–severe COPD patients following 6 weeks of aerobic exercise training. The improvement in submaximal performance after exercise training was associated with parasympathetic activity.

Hamilton et al., (1996)

They analyzed the physiological link between weakness, leg fatigue, and exercise intolerance. They evaluated the relationship between the perception of leg fatigue, work capacity, and muscle strength in normal individuals and patients with lung diseases, most of whom had COPD. Three interrelated observations, valid in

healthy individuals and patients with lung diseases, were made *1*) for a given power output, the perception of leg fatigue was greater in weaker compared with stronger individuals, *2*) peak exercise capacity was reduced in weak individuals, and *3*) the strength of the quadriceps was a key determinant of exercise capacity, independent of the impairment in lung function.

N.A. Hernandes et al., (2010)

This study aimed to investigate the reproducibility of two 6MWTs performed on subsequent days in a large and representative sample of patients with chronic obstructive pulmonary disease (COPD), and to quantify the learning effect between the two tests, as well as its determinants. The 6MWT was statistically reproducible in a representative sample of patients with COPD. However, the vast majority of patients improved significantly in the second test by an average learning effect of 27 m.

Hodgev VA et al., (2003)

The present study aims at comparing the cardiovascular and dyspnea responses to 6MWT and ISWT in patients with chronic obstructive pulmonary disease (COPD). Twenty patients with clinically stable COPD (age, 56 +/- 9 yrs; BMI, 27.8 +/- 7.7 kg.m(-2); FEV1%pred, 42 +/- 19%; mean +/- Sx) performed

three 6MWTs and two ISWTs using standardised protocols. The distances walked in the third 6MWT and second ISWT were 458 +/- 105 and 365 +/- 116 m, respectively. The cardiovascular and dyspnea response caused by ISWT is greater (but statistically not significant) than that generated by 6MWT. The more limited the functional capacity of COPD patients the more similar the response generated by 6MWT and ISWT.

Poulain N et al., (2008)

We evaluated exercise-induced desaturation during 6-min walk testing (6MWT) in comparison with CPET in patients with COPD and determined the reproducibility of the phenomenon. Twenty-eight percent of patients with COPD presented DND. The phenomenon was reproducible and not protocol dependent, emphasizing the clinical interest of the 6MWT.

Hennake et al., (2007)

The present study investigated physiologic and systemic immunologic responses to a 6MWT in muscle-wasted patients with COPD and compared them with maximal cardiopulmonary exercise testing (CPET). This study shows that a 6MWT induces a systemic immunologic response in muscle-wasted patients with COPD, which is comparable to CPET-induced responses. The correlation between

systemic oxidative stress and the degree of muscle wasting supports a possible causal relation between systemic inflammation, oxidative stress, and muscle wasting

Troosters et al., (2002)

The study examines the physiological responses during encouraged 6MWT in patients with chronic obstructive pulmonary disease. The study demonstrates that an encouraged 6-min walking test generates a high but sustainable oxygen uptake. Since the oxygen uptake plateau reflects the integrated response of the system, it may explain the high prognostic value of the 6-min walking test.

Eduardo Márquez-Martín et al., (2011)

This study attempted to explore the possible relationship between the extent of emphysema, as assessed by high-resolution computed tomography (HRCT), and COPD severity. They found that, Compared with subjects with a no emphysematous phenotype, subjects with an emphysematous phenotype has a different profile in terms of BMI, lung function, PMS, and exercise capacity

Anoma Santiworakul et al., (2009)

This study indented to investigate the effect of lower extremity exercise on maximum lower extremity muscle strength and physical capacity in COPD

patients. Twenty moderate to very severe COPD patients were allocated into trained and control groups. The trained group received eight weeks of lower extremity functional exercise including forward step up, lateral step up, heel raise, and lunge at home. Functional exercise may improve physical capacity in moderate to very severe COPD patients. It is beneficial and easy to perform at home.

Mador MJ, Bozkanat E (2001)

An exercise program for improving the skeletal muscle dysfunction in COPD, especially muscle training will be helpful in the mechanism of deconditioning from disuse that is believed to be a major contributing factor of the skeletal muscle dysfunction.

Debigaré et al., (2001)

They tried to estimate the degree of peripheral skeletal muscle abnormality, they looked at mid-thigh muscle cross-sectional area (CSA) by CT scan, choosing a cutoff value for abnormal based on the findings of a previous study of clinical outcome in patients with COPD. Data collected from 45 men with COPD in stable condition who had no evidence of current “inflammatory disease” and had participated in a prior study of muscle mass and survival.. While not drawing a conclusion about causality, the authors suggested that these data indicated a shift toward catabolism that may contribute to the development of decreased peripheral

skeletal muscle mass. One point that deserves emphasis, however, is that loss of muscle mass may or may not be associated with an ongoing loss of muscle mass

Denis EO et al., (2001)

This study examined dynamic hyperinflation during exercise in 105 patients with COPD (FEV_1 = 37 ± 13% predicted; mean ± SD) and studied the relationships between resting lung volumes, dynamic hyperinflation during exercise, and peak oxygen consumption (VO_2). The extent of inflation during exercise in COPD correlated best with resting inspiratory capacity. DH curtailed the VT response to exercise. This inability to expand tidal volume in response to increasing metabolic demand contributed importantly to exercise intolerance in COPD.

Satta et al., (1999)

This study aimed to investigate the relationship between skeletal muscle, fibre type composition, functional respiratory impairment and exercise tolerance in patients with moderate to severe chronic obstructive pulmonary disease (COPD). A group of 22 COPD patients and 10 healthy control subjects were studied. We conclude that reduced oxygen availability, probably in combination with muscle disuse, may determine muscle alterations in chronic obstructive pulmonary disease patients. The altered correlations between myosin heavy chain and light chain

informs suggest that co-ordinate protein expression is lost in chronic obstructive pulmonary disease muscles.

Maltant et al.,(2002)

This study was conducted study to asses the systemic complications of patients with COPD. Peripheral muscle weakness is a complication of COPD which results in atrophy, weakness and low oxidative capacity. The decrease exercise tolerance and quality of life is attributed to the peripheral muscle weakness and impaired lung function. The study findings concludes that the peripheral muscle weakness is due to the impaired lung function and this in turn leads to other systemic complications in patients with COPD patients.

III METHODOLOGY

3.1 STUDY DESIGN

- An experimental pre-test, post study design.

3.2 STUDY SETTING

- Pulmonology Outpatient Department, K.G. Hospital Coimbatore.

3.3 STUDY DURATION

- The total study duration was conducted for a period of 6 months.
- Intervention period was for 8 weeks

3.4 STUDY SAMPLING

A total of 30 patients (18 male and 12 female) with clinical diagnosis of COPD were allocated to a control and experimental group. The samples were selected using convenient sampling method.

3.5 SELECTION CRITERIA

INCLUSION CRITERIA

- Male and female COPD patients.(18 male and 12 female)
- Moderate obstruction (GOLD Classification – FEV1, FVC < 70% and FEV1 <80% predicted)
- Age group range from 45 to 60 years

EXCLUSION CRITERIA

Subjects with,

- Neurological problems
- Symptomatic heart disease
- Uncontrolled hypertension
- Diabetic mellitus
- Musculo-skeletal problems
- On perdnisolone more than 10mg/day
- Psychological unstable players.

3.6 OUTCOME PARAMETER

- Functional capacity

3.7 TOOLS

- 6 Minute Walk Distance Test

3.8 OPERATIONAL TOOLS

- Block
- 2 chair
- Stop watch
- Inch tape

3.9 PROCEDURE

30 male and female patients, who met the inclusion criteria, were asked to sign the informed consent form.

The selected patients were interviewed about their age, weight, height and smoking habits. They were asked to do a PFT to classify the level of COPD. These patients were randomized to 2 groups of 15 patients each who took the 6 minute walk distance test.

6 minute walk distance

In the 6 minute walk distance test, the walk way in which the test was done, was a 15 meter corridor. 2 chairs were placed at each end that marked the 15 m.

Instructions given to the patients were based on the standard procedures of “American Thoracic Society (ATS)” for measurement of 6 minute walk distance (Appendix I). The parameter chosen to assess the patients, functional capacity in this test was distance. The values were recorded both before and after the walking test was performed.

GROUP A

Functional lower extremity exercise

I. ***Total duration of intervention:*** 8 weeks

II. ***Frequency of training:*** 3 times / day

a. Number of session/day (ie) Morning session

Noon session

Evening session

b. Number of days/week: 3 days/week

III. ***Warm up:*** patients were asked to stretch the following lower limb muscles:

i. Gluteus

ii. Quadriceps

iii. Hamstrings

iv. Gastrosolus

All at 3 – 5 reps/muscle group

IV. Type of functional exercise for lower limb:

4 types of exercise:

a. Heel raise

b. Forward step up

c. Lateral step up

d. Lunges

Each type of these 4 exercise position were further divided based on intensity into 5 steps.

V. Determination of each individuals exercise level:

- Individual appropriate exercise level in each position was determined based on the Number of repetitions the patients could perform in a step (ie) the exercise intensity 1 level will be No of steps that he/she could not perform maximum more than 15 repetitions because of leg fatigue.
- The final step and Number of repetitions the patients could perform were recorded as the 1st exercise level/ intensity of the patient from which they were progressed to.

VI. Progression of exercise level:

- 1st 4 weeks – intensity of steps 1 -3 was progressively increased based on factors:
    a. Body position
    b. Gravity
- For step 4 and 5, intensity was increased during 2nd next weeks.
    - Elastic band
        - Single band – for step 4
        - Double band – for step 5

The 6 minute walk distance test was repeated at the completion of 8 weeks and the distance was recorded which was subjected to data analysis.

GROUP B (Control group)

Subjects were taught simple postural adaptation for breathlessness

3.9 STATISTICAL TOOL

Paired ‘t’ test

The following statistical tool is used to compare pre test and post test values within the groups.

Formula: Paired t-test

$$S = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

$$t = \frac{\overline{d}\sqrt{n}}{s}$$

Where,

d = difference between the pre test versus post test

$\overline{d}$ = mean difference

n = total number of subjects

S = standard deviation

Unpaired ‘t’ test:

The unpaired‘t’ test was used to compare the pre test and post test values between the two groups.

Formula: Unpaired t-test

$$S = \sqrt{\frac{\sum\left(X_1 - \overline{X_2}\right)^2 + \sum\left(X_2 - \overline{X_2}\right)^2}{n_1 + n_2 - 2}}$$

$$t = \frac{\overline{X_1} - \overline{X_2}}{S}\sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where,

$\overline{x_1}$ = Mean of Group A

$\overline{x_2}$ = Mean of Group B

$\sum$ = sum of the value

n_1 = number of subjects in Group A

n_2 = number of subjects in Group B

S = standard deviation

IV DATA ANALYSIS AND INTERPRETATION

TABLE-I

PAIRED 't' TEST

PRE TEST AND POST TEST VALUES OF GROUP A

GROUP A – EXPERIMENTAL GROUP

6 MINUTE WALK DISTANCE TEST

The comparative mean values, mean differences, standard deviation and Paired 't' test values of Group A who were treated with lower extremity functional exercises.

S.NO	TESTS	MEAN	STANDARD DEVIATION	t = VALUE (p < 0.05%)
1	PRE TEST	518.4	8.09	11.794
2	POST TEST	532.6	7.05	

STATISTICAL ANALYSIS

TABLE I

The table I shows analysis of 6 minute walk distance test measurement subjected to dependent 't' testing. The calculated test value for Group A was 11.794 at 0.05 % level of significance, which was greater than the tabulated 't' value 1.761.

The result shows that there was marked difference between pre test and post test values for 6 minutes walk distance test of group A.

GRAPH-I

GRAPHICAL REPRESENTATION OF PRE TEST AND POST TEST VALUES OF GROUP A

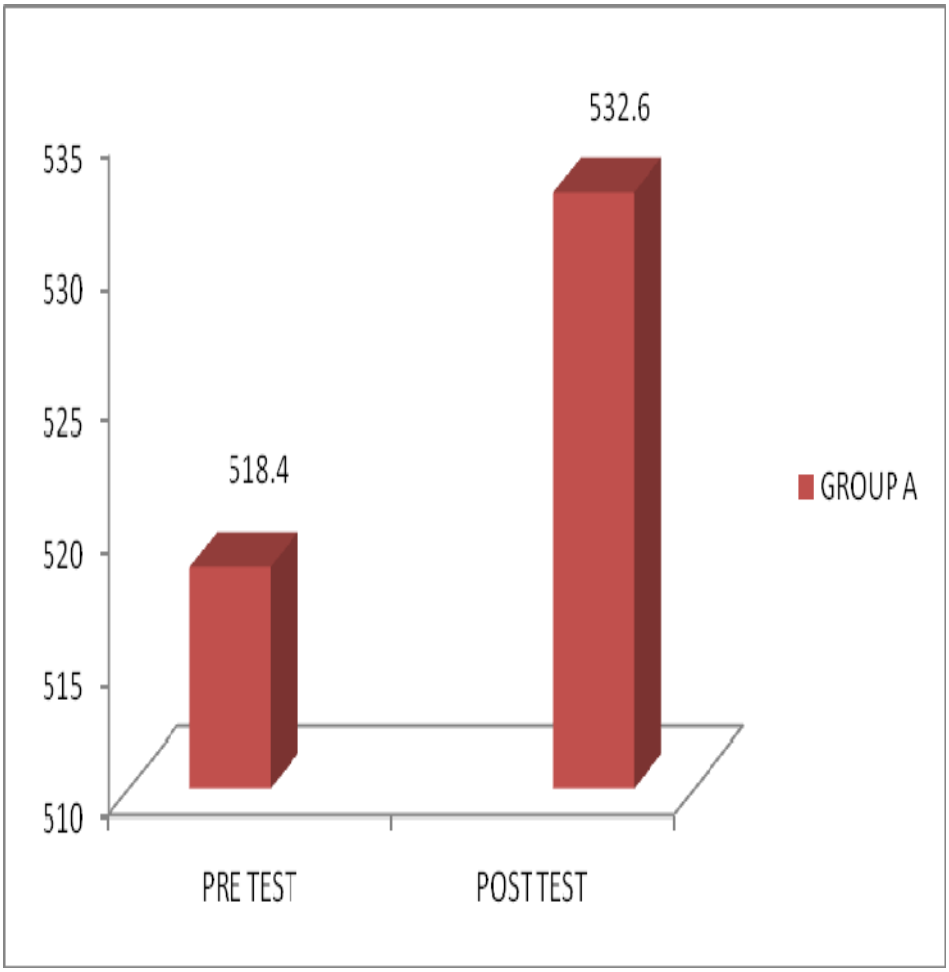


TABLE-II

PAIRED 't' TEST

PRE TEST AND POST TEST VALUES OF GROUP B

GROUP B – CONTROL GROUP

6 MINUTE WALK DISTANCE TEST

The comparative mean values, mean differences, standard deviation and Paired 't' test values of Group A who were treated with lower extremity exercises.

S.NO	TESTS	MEAN	STANDARD DEVIATION	t = VALUE (p>0.05%)
1	PRE TEST	517.4	8.82	3.392
2	POST TEST	519.8	9.88	

STATISTICAL ANALYSIS

TABLE II

The table II shows analysis of 6 minute walk distance test subjected to dependent ‘t’ test. The calculated test value for Group B was 3.392 at 0.05 % level of significance, which was greater than the tabulated ‘t’ value 1.761.

The result shows that there was marked difference between pre test and post test values for 6 minute walk distance test of group B.

\

GRAPH-II

GRAPHICAL REPRESENTATION OF PRE TEST AND POST TEST VALUES OF GROUP B

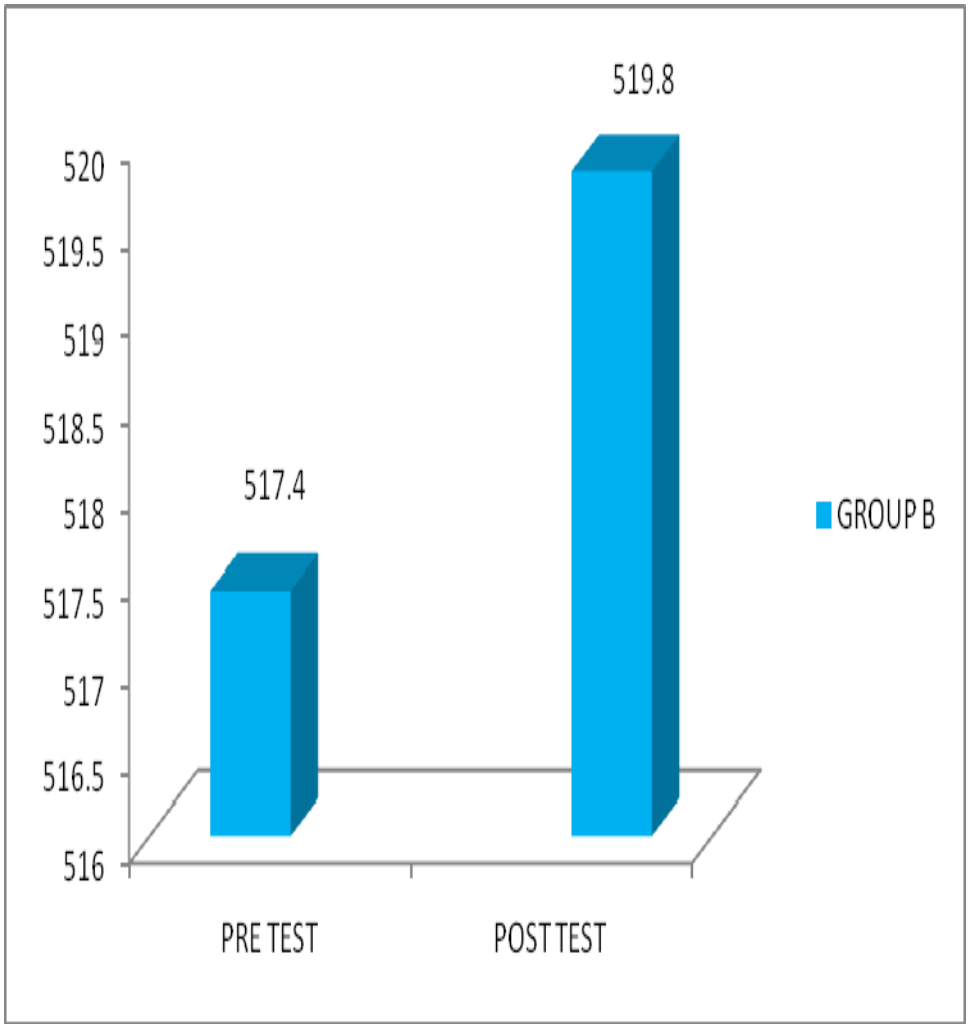


TABLE-III

UNPAIRED‘t’ TEST

COMPARISON BETWEEN THE PRE TEST VALUES OF GROUP A AND B

6 MINUTE WALK DISTANCE TEST

The comparative mean values, mean differences, standard deviation and Paired ‘t’ test values of Group A who were treated with lower extremity exercises.

S.NO	GROUPS	MEAN	STANDARD DEVIATION	t = VALUE (p<0.05%)
1	GROUP A	518.4	8.09	0.30203
2	GROUP B	517.4	8.82	

STATISTICAL ANALYSIS

TABLE III

The table III shows analysis of 6 minute walk distance test on unpaired ‘t’ test. The pre test values for Group A and Group B was 0.3020 at 0.05 % level of significance, which was lesser than the tabulated ‘t’ value 1.701.

The result shows that there was no marked difference between pre test and post test values of both the groups.

GRAPH-III

GRAPHICAL REPRESENTATION OF PRE TEST VALUES FOR GROUP A AND GROUP B

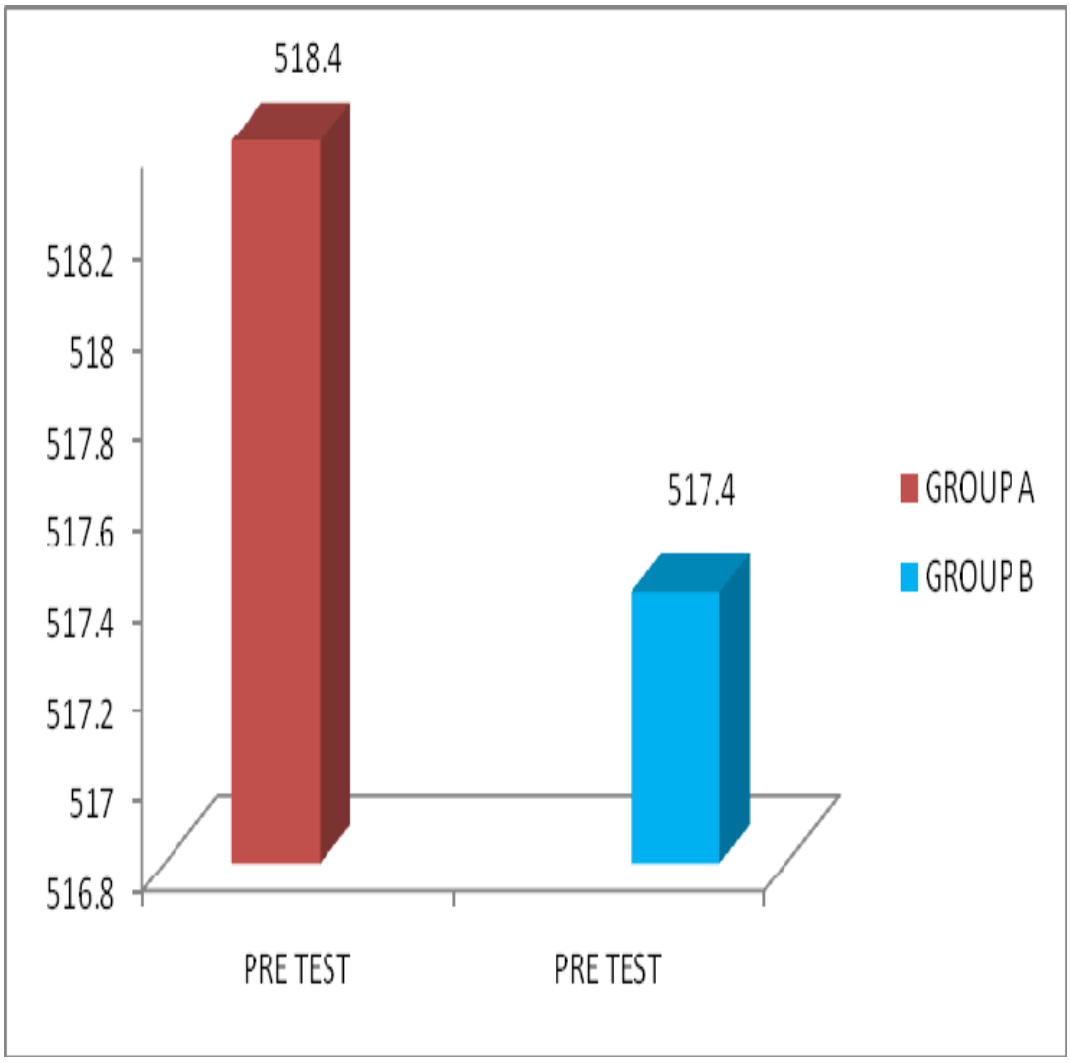


TABLE-IV

UNPAIRED‘t’ TEST

COMPARISON BETWEEN THE POST TEST VALUES OF GROUP A AND B

6 MINUTE WALK DISTANCE TEST

The comparative mean values, mean differences, standard deviation and Unpaired ‘t’ test values of Group A and Group B who were treated with lower extremity functional exercises.

S.NO	GROUPS	MEAN	STANDARD DEVIATION	t = VALUE (p<0.05%)
1	GROUP A	532.6	7.05	4.084
2	GROUP B	519.8	9.88	

STATISTICAL ANALYSIS

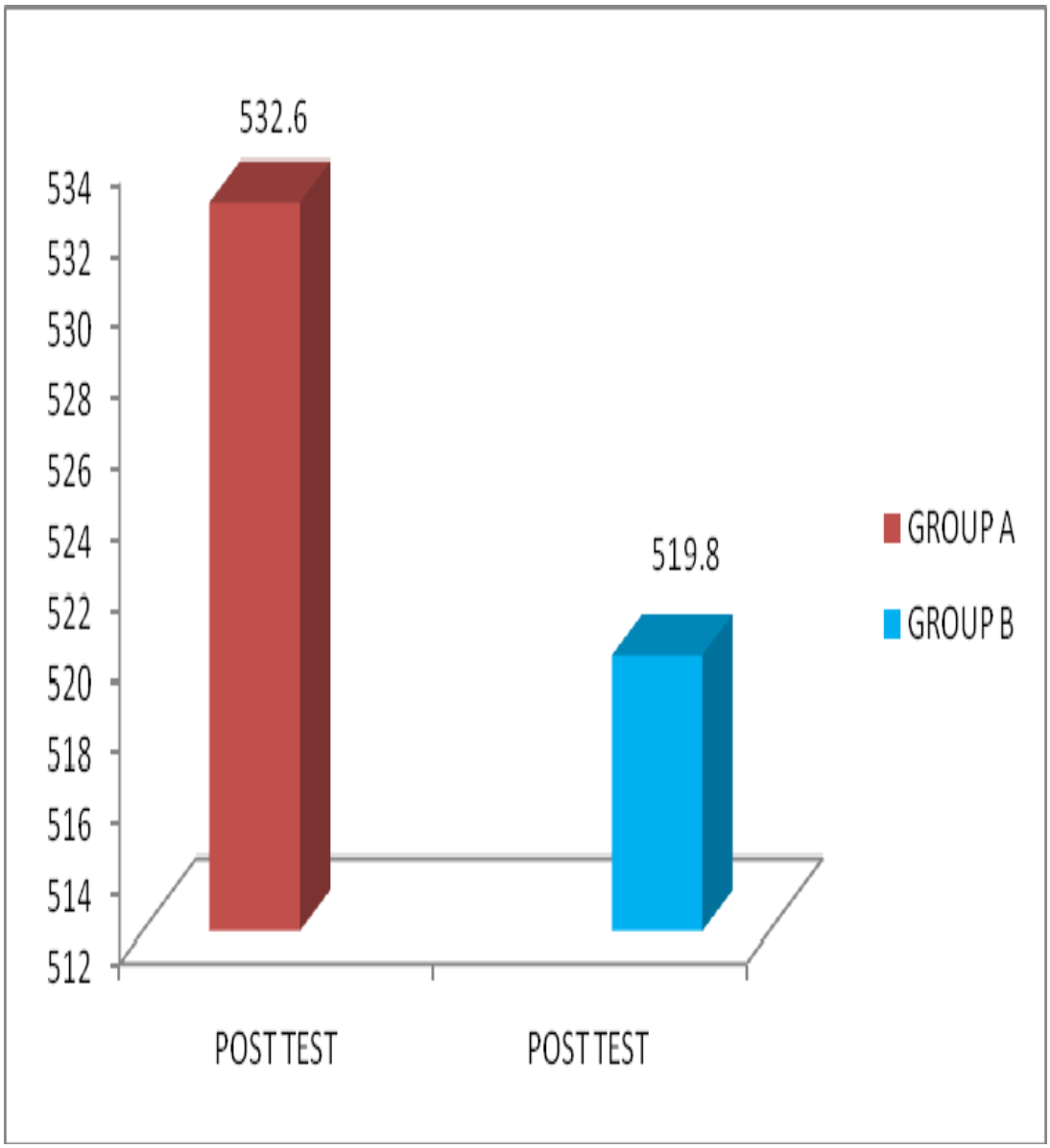
TABLE IV

The table IV shows analysis of 6 minute walk distance test measurements on on unpaired ‘t’ test. The post test values for Group A and Group B subjected to independent ‘t’ testing showed a calculated t value of 4.084 at 0.05 % level of significance, which was greater than the tabulated ‘t’ value 1.701.

The result shows that there was marked difference between post test values of Group A and Group B for 6 MWD measurements.

GRAPH-IV

GRAPHICAL REPRESENTATION OF POST TEST VALUES FOR GROUP A AND GROUP B



V DISCUSSION

This study was basically conducted to analyze the effect of lower extremity functional exercise on the physical capacity in moderate COPD patients..A total of 30 patients (18 male, 12 female) who were clinically diagnosed of moderate COPD patients (PFT results of FEV1 / FVC of < 75% based on ATS classification) were selected and allocated a single group.

These subjects underwent a training program for a total duration of 8 weeks that comprised 4 types of functional exercise for the lower limb that consist of 5 steps which indicated the exercise level / intensity. The 6 MWD test was used before and after the training program to assess the functional capacity of subjects.

Respiratory and peripheral muscle weakness and de – conditioning are currently recognized in chronic obstructive disease populations as extra factors noted are reduction in functional exercise capacity and also in the quality of life . The inspiratory muscle function is commonly noted to be affected (reduced strength and endurance) in patients with COPD. Biomechanical change of the thoracic wall and potential structural changes on the inspiratory muscle results in inspiratory muscle dysfunction.

Several studies have examined the effects of weight training alone in patients with COPD.(Simpson et al, 1992; Clark et al, 2000; Bernard et al, 1999) Weight training in patients with COPD has resulted in increases in muscle strength and size. In addition, weight training significantly improved performance of whole-body endurance exercise. Traditional pulmonary rehabilitation focuses primarily on aerobic endurance training. Endurance training in patients with COPD consistently leads to clinically significant improvement in sub maximal exercise performance with variable effects on maximal exercise capacity.

While some of this improvement may be related to psychological factors, there is increasing evidence that endurance training results in physiologic changes within the exercising muscle. Improvements in oxidative enzyme capacity, cellular bioenergetics, and a reduction in fatigability have all been demonstrated in the quadriceps muscle in patients with COPD after pulmonary rehabilitation. The decrease in arterial oxygen content may cause dyspnea during activity, which typically results in an avoidance of activity and facilitates further deconditioning

Anoma Santiworakul et al (2009) in the J med Association thai stated that exercise intolerance is a characteristic and greatly troubling indication of COPD. These patients are limited commonly in this ability to perform usual tasks

such as work activities. The impaired muscle strength and endurance are associated with reduced exercise capacity which leads to impaired poor quality of life.

Coming across this literature leads to the formulation of this study Based on this, the relative physiotherapeutic intervention which would be ideal and feasible was sought out.

Since, 1960's walking tests have been around as a quick and easy fitness test to assess a patient's functional capacity. As objects measures are better than self reports as the patients true functional capacity may be over or under estimated. The case of performing a 6 MWD test falls between stair climbing and testing for exercise induced asthma. This test is easier to administer, belted tolerated and better reflects activities of daily living than other walk tests. The primary measurement is the total distance walked when compared to dyspnea and fatigue which is measured using a borg or visual analogue scale respectively. **Paul Enright (2003)**

Exercise intolerance is evident in COPD patients .Functional impairment is obviously seen by lower walking capacity and cycling endurance compared with age matched , healthy controls .Reduced functional status and reduced levels of daily physical activity predilict poor QOL and mortality .

AM phys , Jou of Applied physiology , Aug 2008 . Richard Debigare and Maltaire stated that denial of this concept and its omission will disservice the

COPD patient , since lower limb muscles dysfunction can be , in contrast to lung impairment be amenable to therapy by rehabilitation strategies .

It was proved that improvement in 6MWD may also come from respiratory and neuromuscular system. Ventilator demands decrease during training, desensitizing dyspnea, which was considered to be the mechanism for improving the respiratory system which would invariably improves the individual's functional or physical capacity. **AM J (1999)**

In a study conducted by O'Donnell et al, (1998) in AMJ Respiratory critical care Med the effect of general exercise on muscle performance and 6 MWD was analyzed. A significant difference in 6 MWD between control and trained group was found.

The effect of lower intensity peripheral muscle exercise of extremities and pulmonary function, muscle performance and exercise capacity was studied by **Claek et al (1996)**. Based on this it was understand that functional exercise is the best counter measure to muscle dysfunction. As the effect of this functional exercise in low loading strengthening exercise in COPD patients has not been analyzed so far, this study was designed to analyze the same

VI CONCLUSION

This study was focused on analyzing the effects of functional exercise , for the lower limbs in moderate COPD patients.30 subjects were randomized into experimental and control groups ie group A and group B .

After 8 weeks of intervention which consisted of functional exercise , the functional capacity of these individuals was assessed using the 6 minute walk distance test .

The data was collected at the end of 6 minute walk distance test which was subjected to data analysis . The post test values of the 6 minute walk distance test for both the groups were subjected to independent ‘t’ testing . The calculated ‘t’ value of 1.708 at a confidence level of 95% .

Therefore it was determined that there is a significant difference in the functional capacity of moderate COPD individuals after being subjected to functional exercises of the lower limbs . Thereby the null hypothesis was rejected and the alternate hypothesis was accepted.

VII LIMITATIONS AND RECOMMENDATION

LIMITATION

- The sample size was limited to 30.
- Study was conducted focusing mainly on moderate COPD patients.
- The effects of functional exercise on muscle strength and endurance was not assessed.
- Improvement in 6 minute walk distance test did not specify the improvement system , it could determine overall involved systems during exercises.
- The usage of drugs and inhaled bronchodilators was an extraneous factor.
- Only the American Thoracic Society Guidelines was followed to perform the 6 minute walk distance test.
- Factors that are associated with longer 6 minute walk distance were not excluded.

For example

1. Taller individuals
2. Male gender
3. High motivator
4. Patients who have previously performed the test
5. Medication for a disabling disease taken just before the test.

RECOMMENDATION

- Further studies can be done with larger samples.
- Studies can be done to emphasize on the progressive loading of functional exercise programme for strengthening lower extremity muscles.
- Intervention duration of more than 8 weeks should be considered in pulmonary rehabilitation for significant effects.
- Assessment of physiological parameters should be considered.
- Quality of life is another outcome measure recommended to asses in further studies.

VIII BIBILIOGRAPHY

1. Ries AL, Bauldoff GS, Carlin BW, Casaburi R, Em CF, Mahler DA, et al. Pulmonary rehabilitation: Joint ACCP/AACVPR evidence-based clinical practice guidelines. Chest 2007; 131: 4S-42S.
2. Bourjeily G,Rochester CL. Exercise training in chronic obstructive pulmonary disease. Clin Chest Med 2000; 21: 763-81.
3. Pitta F, Troosters T, Spruit MA, Probst VS,Decramer M, Gosselink Characteristics of physical activities in daily life in chronic obstructive Pulmonary disease. Am J Respir Crit Care Med 2005; 171: 972-7.
4. Gallagher CG. Exercise limitation and clinical exercise testing in chronic obstructive pulmonary disease. Clin Chest Med 1994; 15: 305-26.
5. Richardson RS, Sheldon J, Poole DC, Hopkins SR,Ries AL, Wagner PD. Evidence of skeletal muscle metabolic reserve during whole body exercise in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1999; 159:881-5.
6. Skeletal muscle dysfunction in chronic obstructive pulmonary disease. Statement of the American Thoracic Society and European Respiratory Society Am J Respir Crit Care Med 1999; 159:S1-40.

7. Bernard S, LeBlanc P, Whittom F, Carrier G, Jobin J,Belleau R, et al. Peripheral muscle weakness in patients with chronic obstructive pulmonary Disease. Am J Respir Crit Care Med 1998; 158:629-34.
8. Hamilton AL, Killian KJ, Summers E, Jones NL.Muscle strength, symptom intensity, and exercise capacity in patients with cardio respiratory Disorders. Am J Respir Crit Care Med 1995; 152:2021-31.
9. G**oss**elink R, Troosters T, Decramer M. Peripheral muscle weakness contributes to exercise limitation in COPD. Am J Respir Crit Care Med 1996; 153:976-80.
10. Mador MJ, Bozkanat E. Skeletal muscle dysfunction in chronic obstructive pulmonary disease. Respir Res 2001; 2: 216-24.
11. Allaire J, Maltais F, Doyon JF, Noel M, LeBlanc P, Carrier G, et al. Peripheral muscle endurance and the oxidative profile of the quadriceps in patients with COPD. Thorax 2004; 59: 673-8.
12. Mador MJ, Deniz O, Aggarwal A, Kufel TJ Quadriceps fatigability after single muscle exercise in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 2003; 168: 102-8.
13. Couillard A, Maltais F, Saey D, Debigare R, Michaud A, Koechlin Cetal. Exercise-induced quadriceps oxidative stress and peripheral

muscle Dysfunction in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 2003; 167: 1664-9.

14. Decramer M, Gosselink R, Troosters T, Verschueren M, Evers G. Muscle weakness is related to utilization of health care resources in COPD patients. Eur Respir J 1997; 10: 417-23.

15. Hernandez MT, Rubio TM, Ruiz FO, Riera HS, Gil RS, Gomez JC. Results of a home-based training program for patients with COPD. Chest 2000; 118:106-14.

16. Cress ME, Conley KE, Balding SL, Hansen-Smith F, Konczak J. Functional training: muscle structure,function, and performance in older women. J Orthop Sports Phys Ther 1996; 24: 4-10.

17. Wang MY, Flanagan S, Song JE, Greendale GA,Salem GJ. Lower-extremity biomechanics during forward and lateral stepping activities in older adults. Clin Biomech (Bristol , Avon) 2003; 18:214-21.

18. Clark CJ, Cochrane L, Mackay E. Low intensity peripheral muscle conditioning improves exercise tolerance and breathlessness in COPD. Eur Respir J 1996; 9: 2590-6.

19. O'Donnell DE, McGuire M, Samis L, Webb KA. General exercise training improves ventilator and peripheral muscle strength and

endurance in chronic airflow limitation. Am J Respir Crit Care Med 1998; 157: 1489-9

20. Loy SF, Conley LM, Sacco ER, Vincent WJ, Holland GJ, Slattern EG, et al. Effects of stair climbing on VO2max and quadriceps strength in middle-aged females. Med Sci Sports Exerc 1994; 26:2417.

21. Bean J**,** Herman S, Kiely DK, Callahan D, Mizer K, Frontera WR, et al. Weighted stair climbing in mobility-limited older people: a pilot study. J Am Geriatr Soc 2002; 50: 663-70.

22. Global Initiative for Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary Disease. NHLBI/WHO Workshop, Bethesda: National Heart, Lung and Blood Institute; 2003.

23. Cockcroft AE, Saunders MJ, Berry G. Randomised controlled trial of rehabilitation in chronic respiratory disability. Thorax 1981Mar;36(3):200-3.

24. McGavin CR, Gupta SP, Lloyd EL, McHardy GJR. Physical rehabilitation for the chronic bronchitis: results of a controlled trial of exercises in the home. Thorax 1977;32:307-11.

25. Lake FR, Henderson K, Briffa T, Openshaw J, Musk AW. Upper-limb and lower-limb exercise training in patients with chronic airflow Obstruction. Chest 1990 May;97(5):1077-82.27. Booker HA. Exercise training and breathing control in patients with Chronic airflow limitation. Physiotherapy 1984;70:258-60.

26. Jones DT, Thomson RJ, Sears MR. Physical exercise and resistive Breathing training in severe chronic airways obstruction--are they Effective? Eur J Respir Dis 1985 Sep;67(3):159-66.

27. **Troos**ters T, Gosselink R, Decramer M. Short and long-term effects of Outpatient pulmonary rehabilitation in COPD patients, a randomized Controlled trial. Am J Med 2000 Aug 15;109(3):207-12.

28. Larson JL, Covey MK, Wirtz SE, Berry JK, Alex CG, Langbein WE, et al. Cycle ergometer and inspiratory muscle training in chronic Obstructive pulmonary disease . Am J Respir Crit Care Med 1999 Aug;160(2):500-7.

29. Hernandez MTE, Montemayor Rubio T, Ortega Ruiz F, Sanchez Riera H, Sanchez Gil R, Castillo Romez J. Results of a home-based training program for patients with COPD. Chest 2000;118:106-14.

30. Gosselink R, Troosters T, Decramer M. Exercise training in COPD patients: interval training vs endurance training. Eur Respir J 1998;12(Suppl. 28):2s.

31. Puhan MA, Busching G, Schunemann HJ, VanOort E, Zaugg C, Frey M. Interval versus continuous high-intensity exercise in chronic Obstructive pulmonary disease . A randomized trial. Ann Intern Med 2006 Dec 5;145(11):816-25.

32. Coppoolse R, Schols AMWJ, Baarends EM, Mostert R, Akkermans MA, Janssen PP, et al. Interval versus continuous training in patients with severe COPD: a randomized clinical trial. Eur Respir J 1999;14:258-63.

33. Berna rd S, Whittom F, Leblanc P, Jobin J, Belleau R, Berube C, et al. Aerobic and strength training in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1999;159:896-901.

34. Clark CJ, Cochrane LM, Mackay E, Paton B. Skeletal muscle strength And endurance in patients with mild COPD and the effects of weight Training . Eur Respir J 2000;15:92-7.

35. Simpson K, Killian K, McCartney N, Stubbing DG, Jones NL. Randomised controlled trial of weightlifting exercise in patients with chronic airflow limitation. Thorax 1992 Feb;47(2):70-5.

36. Ries AL, Ellis B, Hawkins RW. Upper extremity exercise training in chronic obstructive pulmonary disease. Chest 1988 Apr;93(4):688-92.

37. Ortega F, Toral J, Cejudo P, Villagomez R, Sanchez H, Castillo J, et al. Comparison of effects of strength and endurance training in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 2002 Sep 1;166(5):669-74.

38. Normandin EA, McCusker C, Connors M, Vale F, Gerardi D, ZuWallack RL. An evaluation of two approaches to exercise conditioning in pulmonary rehabilitation. Chest 2002 Apr;121(4):1085-91.

39. Wurtemberger G, Bastian K. [Functional effects of different training in patients with COPD]. Pneumologie 2001 Dec;55(12):553-62.

40. Spruit M, Gosselink R, Troosters T, De Paepe K, Decramer M. Resistance vs endurance training in patients with COPD and peripheral Muscle weakness. Eur Respir J 2002;19:1072-8.

41. Bernard S, Whittom F, Leblanc P, Jobin J, Belleau R, Berube C, et al. Aerobic and strength training in patients with chronic obstructive Pulmonary disease . Am J Respir Crit Care Med 1999;159:896-901.

42. Clark CJ, Cochrane LM, Mackay E, Paton B. Skeletal muscle strength and endurance in patients with mild COPD and the effects of weight training. Eur Respir J 2000;15:92-7.

43. Simpson K, Killian K, McCartney N, Stubbing DG, Jones NL. Randomized controlled trial of weightlifting exercise in patients with chronic airflow limitation. Thorax 1992 Feb;47(2):70-5.

APPENDIX – IX

APPENDIX - I

CONSENT FORM

This is to certify that I _____ freely and voluntarily agree to participate in the study **"AN EXPERIMENTAL STUDY TO ANALYSE THE EFFECTS OF LOWER EXTREMITY FUNCTIONAL EXERCISE ON THE PHYSICAL CAPACITY IN MODERATE COPD PATIENTS".**

I have been explained about the procedures and the risks that would occur during the study.

Participant:

Witness:

Date:

I have explained and defined the procedure to which the subject has consented to participate.

Researcher:

Date:

APPENDIX-II

CARDIOPULMONARY ASSESSMENT

Name :

Age :

Sex :

Occupation :

Height : Date of Admission :

Weight : Date of assessment :

Chief complaints :

HISTORY

Present medical history :

Past medical history :

Family history :

Social History :

Personal History :

Associated problem :

Vital signs:

Heart rate :

Blood Pressure :

Respiratory rate :

Temperature :

OBJECTIVE ASSESSMENT

On observation

Built :

Color :

Chest shape :

Symmetry :

Breathing pattern :

Chest movement :

Intercostals retraction :

Periphery/extremities :

Clubbing :

Cyanosis :

Respiratory distress :

Type of respiration :

Use of assessor muscles :

Vocal fremitus :

On Palpation:

Tracheal deviation :

Chest expansion :

- ✓ Axilla
- ✓ Nipple level
- ✓ Xiphoid

Tenderness :

Oedema :

On Examination

On Auscultation

Heard sounds :

Lung sounds :

Abnormal breath sound :

Wheeze Rails

Rhonchi Crepitus

INVESTIGATION:

X-Ray :

E.C.G :

Echocardiogram :

ABG Analysis :

Blood test :

Exercise tolerance :

DIAGNOSIS:

APPENDIX –III

GOLD Classification of COPD

Table 1 GOLD Classification of COPD	
Stage	**Characteristics**
0: At risk	Normal spirometry Chronic symptoms (cough, sputum production)
I: Mild COPD	FEV1/FVC ‹ 70% FEV1 greater than or equal to 80% predicted With or without chronic symptoms (cough, sputum production)
II: Moderate COPD	FEV1/FVC ‹ 70% FEV1 greater than or equal to 30% to ‹80% predicted IIa: FEV1 greater than or equal to 50% to ‹ 80% predicted IIb: FEV1 greater than or equal to 30% to ‹ 50% predicted With or without chronic symptoms (cough, sputum production, dyspnea)
III: Severe COPD	FEV1/FVC ‹ 70% FEV1 ‹ 30% predicted or FEV1 ‹ 50% predicted plus respiratory failure or clinical signs of right heart failure
GOLD, Global Initiative for Chronic Obstructive Lung Disease; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in one second; FVC, forced vital capacity; respiratory failure, arterial partial pressure of oxygen ‹ 60 mm Hg with or without arterial partial pressure of carbon dioxide greater than or equal to 50 mm Hg while breathing air at sea level. Source: The GOLD Workshop Panel.[1]	

APPENDIX -IV

ATS GUIDELINES FOR THE SIX MINUTE WALK TEST

INTRODUCTION

The six minute walk test is a a practical test that requires a 100 feet hallway but no exercise equipment or advanced training for technicians . Walking is an activity performed daily by all but the most severely impaired patients .

This test measures the distance that a patient can quickly walk on a flat , hard surface in a period of 6 minutes (6MWD)

INDICATIONS AND LIMITATIONS

- Patients with moderate to severe heart disease or lung disease
- To measure the functional status of the patient
- As a predictor of mortality and morbidity

CONTRAINDICATIONS

- Unstable angina during the previous one month
- Myocardial infarction during the previous one month
- Resting heart rate of more than 120
- Systolic blood pressure of more than 180 mm hg
- Diastolic blood pressure of more than 100 mm hg

1) Testing should be performed in a location where a rapid , appropriate response to an emergency is possible .The appropriate location of a crash cart should be determined by the physician supervising the facility .

2) Supplies that must be made available including oxygen , sublingual nitroglycerine , aspirin and albuterol .

3) The technician should be certified in a cardiopulmonary resuscitation with a minimum of basic life support .Advanced cardiac life support is desirable if available .

4) If a patient is on chronic oxygen therapy, oxygen should be given at their standard rate or as directed by a physician or a protocol .

RATIONALE FOR TEST TERMINATION

1) Chest pain

2) Intolerable dyspnea

3) Leg cramps

4) Staggering

5) Diaphoresis

6) Pale or ashen appearance

TECHINICAL ASPECTS OF 6MWT

Location

The 6MWT should be performed indoors , along a long , flat , straight , enclosed corridor with a hard surface that is seldom traveled .If the weather is comfortable, the rest may be performed outdoors .

Rationale

A shorter corridor requires patients to take more time to reverse directions more often , reducing the 6MWD. Most studies have used a 30 m corridor, but some have used 20 or 50 m .The use of treadmill to determine the 6 MWD might save space and allow constant monitoring during the exercise.

Required Equipment

1. Countdown timer or stopwatch
2. Mechanical lap counter
3. Two small cones to mark the turnaround points
4. A chair that can be easily moved along the walking course
5. Worksheets on a clipboard
6. A source of oxygen

7. Sphygmomanometer

8. Telephone

9. Automated electronic defibrillator

PATIENT PREPARATION

1) Comfortable clothing should be worn

2) Appropriate shoes for walking should be worn

3) Patients should use their usual walking aids during the test

4) A light meal is acceptable before early morning or early afternoon tests

5) The patients usual medical regimens should be continued

6) Patients should not have exercised vigorously within 2 hours of beginning test

MEASUREMENTS

1) Repeat testing should be performed about the same time of day to minimize intraday validity

2) A warm up period before the test should be performed

3) The patient should sit at rest in a chair , located near the starting position , for at least 10 minutes before the test starts .During this time check the contraindications measure pulse and blood pressure and make sure for the clothing and shoes are appropriate .

4) Pulse oximetry optional .If it is performed measure and record baseline heart rate and oxygen saturation and follow manufacturer’s instructions .

APPENDIX-V

BORG SCALE

0.5 very very slight (just noticeable)

1 very slight

2 slight (light)

3 moderate

4 somewhat severe

5 severe (heavy)

6

7 very severe

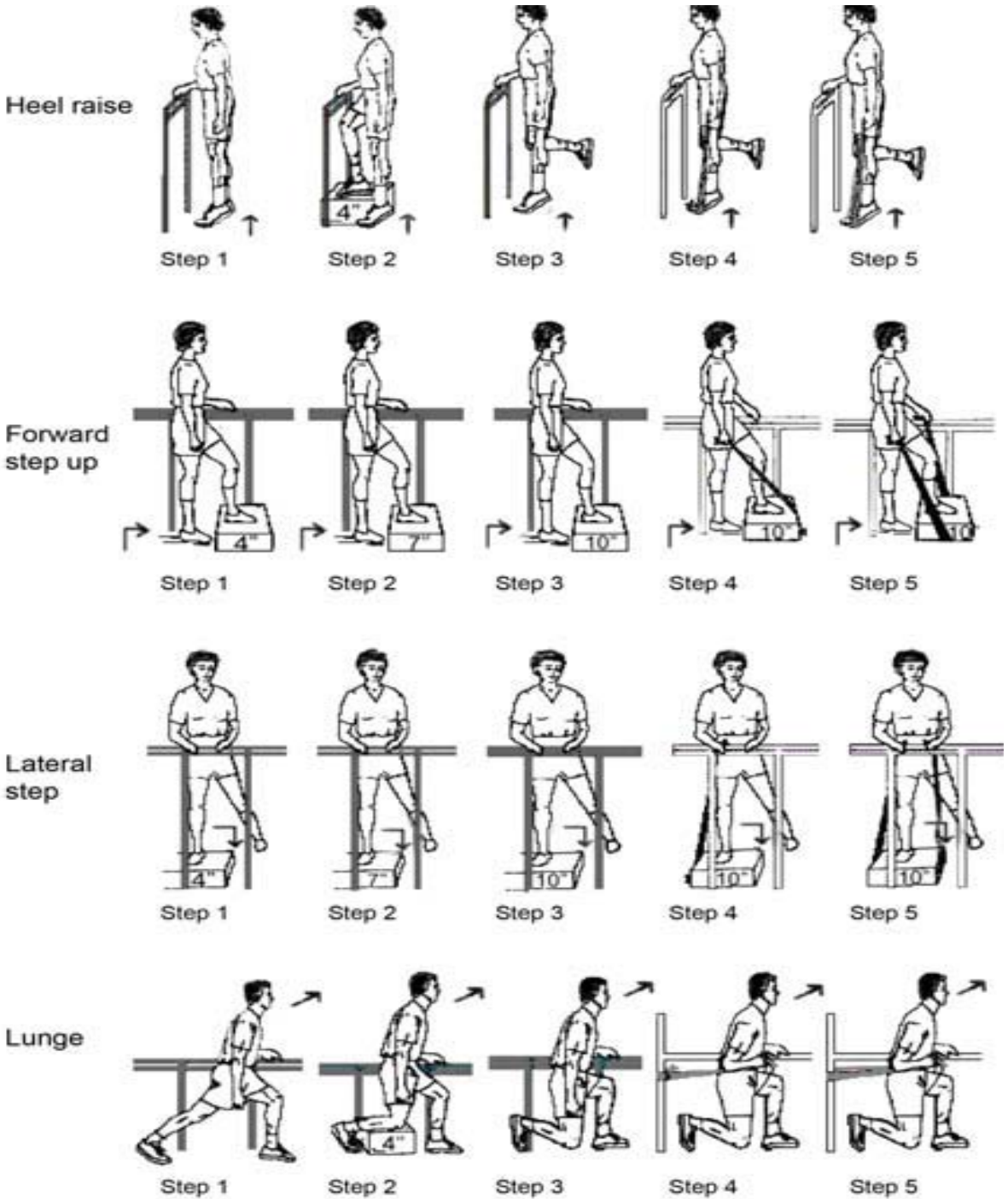
8

9

10. very very severe (maximal)

APPENDIX -VI

STEP UP EXERCISES



APPENDIX -VII

GROUP A PRE TEST AND POST TEST VALUES

S.NO	PRE	POST
1	520	534
2	509	529
3	518	531
4	512	524
5	530	541
6	522	540
7	528	535
8	515	522
9	510	523
10	504	528
11	516	533
12	520	531
13	530	542
14	528	545
15	514	531

GROUP B PRE TEST AND POST TEST VALUES

S.NO	PRE	POST
1	525	526
2	520	521
3	509	510
4	519	521
5	528	530
6	530	531
7	527	529
8	516	519
9	510	512
10	509	514
11	503	503
12	515	516
13	519	521
14	527	538
15	505	506